NASA SBIR/STTR Technologies

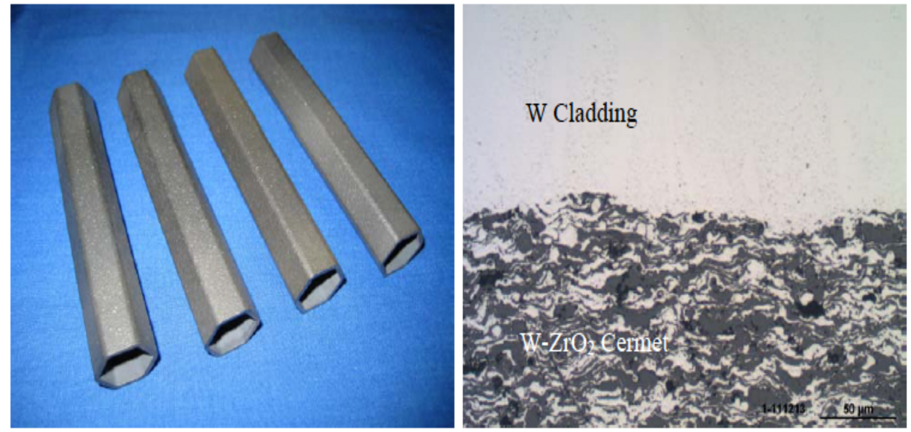
H2.02-8782 - Fine Grained Tungsten Claddings for Cermet Based NTP Systems

PI: John O'Dell
Plasma Processes, LLC. - Huntsville, AL

Identification and Significance of Innovation

- NASA's NCPS program is evaluating the affordability of NTP systems. A critical aspect of the program is to develop a robust, stable nuclear fuel such as cermets comprised of uranium dioxide (UO2) particles encased in a tungsten matrix (W).
- Improved claddings are needed to prevent excessive fuel loss from reaction with the hot hydrogen gas and uranium hydride formation.
- During Phase I, innovative EL-Form and VPS processing techniques were used to produce fine-grained W claddings. Testing showed the W claddings were well bonded to surrogate nuclear fuel element materials, and the W claddings were vacuum tight.

Estimated TRL at beginning and end of contract: (Begin: 3 End: 4)



(Left) – Four VPS W claddings produced during the Phase I investigation. These samples were delivered to MSFC for testing in CFEET. (Right) – Micrograph showing EL-Form® W cladding on W-ZrO2 cermet. Note the good bond between the W cladding and the cermet.

Technical Objectives and Work Plan

- Optimize the EL-Form?? and VPS processing methods for producing dense W claddings for cermet nuclear fuel elements.
- Produce W claddings on cermet materials for characterization in the as-deposited condition and after high temperature exposure, i.e., long duration vacuum furnace trials up to 2000C and thermal cycle testing using an Ar-H2 plasma to temperatures greater than 3000C.
- Perform tests to determine the bond strength of the W claddings on cermet materials.
- Evaluate the different cladding methods and determine the most advantageous techniques for working with cermets containing uranium-based materials.
- Identify the optimum process for producing each of the different W claddings, i.e., channel cladding, preformed exterior cladding, and direct deposition of a cladding on a preformed cermet fuel element.
- Using the most promising methods, produce claddings for subscale fuel elements, which will be delivered to NASA-MSFC for material compatibility testing in its Compact Fuel Element Environment Test (CFEET) facility.
- To demonstrate scalability, develop the fabrication methods needed to produce full size W claddings and deliver these samples to NASA-MSFC for testing in NTR Element Environmental Simulator (NTREES).

NASA Applications

NASA applications that would directly benefit from this technology include Nuclear Thermal Propulsion (NTP) and Nuclear Electric Propulsion (NEP). Currently, NASA's Nuclear Cryogenic Propulsion Stage (NCPS) project is working to demonstrate the viability and affordability of NTP. Potential NASA missions include rapid robotic exploration missions throughout the solar system and piloted missions to Mars and other destinations such as near earth asteroids.

Non-NASA Applications

Government and commercial applications include coatings, defense, material R&D, nuclear power, aerospace, propulsion, automotive, electronics, crystal growth, and medical. Targeted commercial applications include refractory metal rocket nozzles, crucibles, heat pipes, fuel rods, x-ray targets, sputtering targets, turbines, and rocket engines.

Firm Contacts

John O'Dell
Plasma Processes, LLC.
4914 Moores Mill Road
Huntsville, AL, 35811-1558
PHONE: (256) 851-7653
FAX: (256) 859-4134